

Deductive Composition of Multiple Data Sources

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Goal and Technical Objectives

- Answer geographical queries.
- For the public and nonspecialist scientists.
- Allow access to multiple distributed data sources.
- Infer answers where not given explicitly.
- Present visual as well as textual answers.

Technical Problem Statement

- Knowledge (data and programs) is stored in diverse locations and forms.
- People often do not know how to find or access appropriate knowledge sources.
- Answers to queries are rarely present explicitly at any one source.
- Logical inference is needed to answer queries.

Technical Approach

- Develop geospatial ontology and theory to encode geographical facts of life.
- Procedurally attach knowledge sources to symbols in the geospatial theory.
- Translate query into theorem in the language of the geospatial theory.
- Prove theorem automatically and extract answer to query from proof.

Data and NASA Relevance

- Satellite imagery from EOSDIS.
- Alexandria Digital Library Gazetteer, for locations of four million geographical features.
- CIA World Fact Book.
- Application to ecological modeling.
- More generally, deductive treatment of interoperability problems of data and software.

Accomplishments and Preliminary Findings

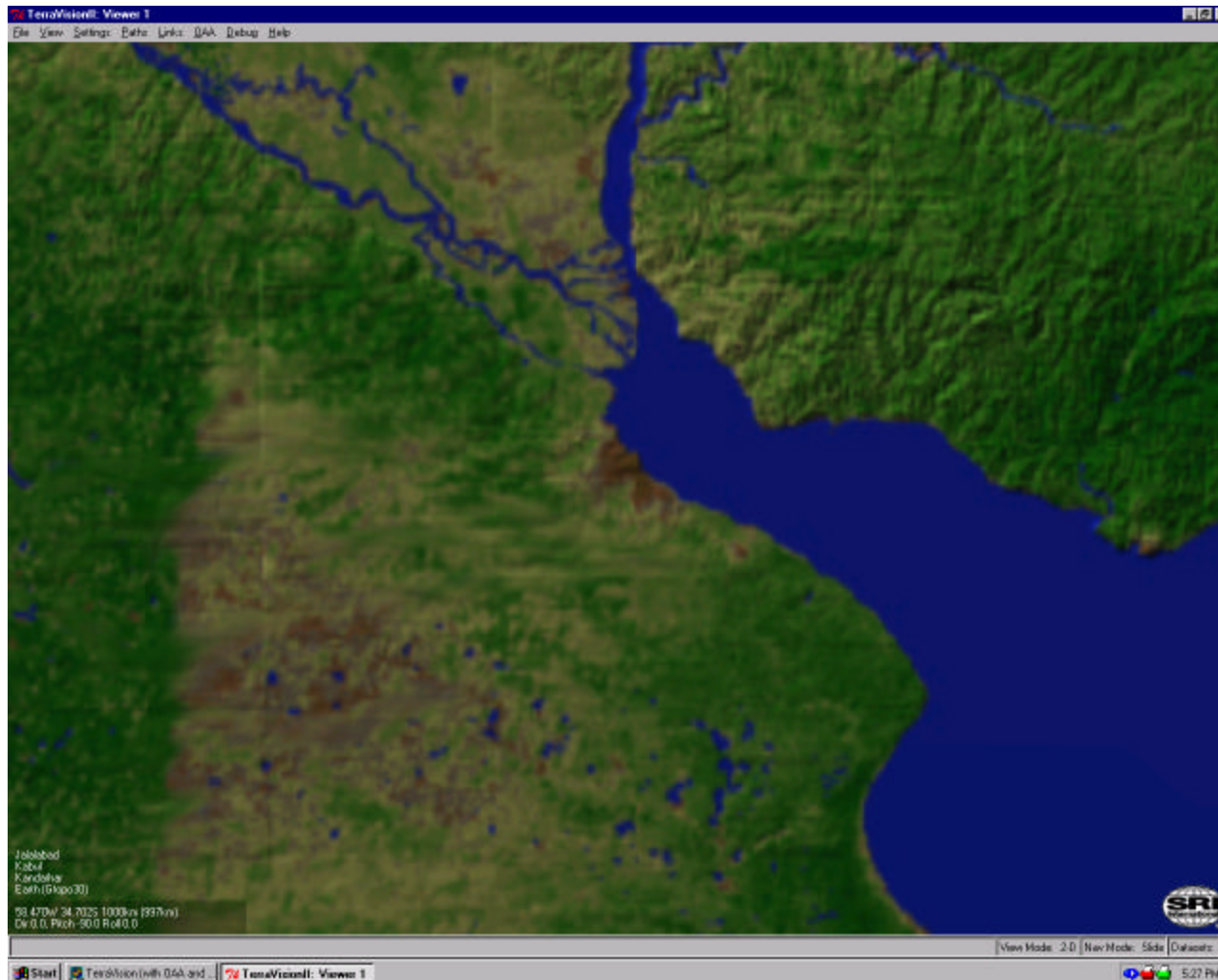
- A preliminary geospatial ontology and theory.
- Use of SNARK theorem prover for inference and answer extraction.
- Procedural attachments for
 - Alexandria Digital Library Gazetteer.
 - Northern Arizona University Lat/Long software.
 - CIA World Fact Book.
- English-language (Gemini) front end.
- Invocation of TerraVision 3D Viewer.

Sample Query

“Show the region 10 km south of the capital of Argentina.”

- Parsed by Gemini into logical form.
- Theorem proved by SNARK.
 - Capital provided by CIA World Fact Book.
 - Location of Argentina and Buenos Aires provided by ADL gazetteer.
 - Location 10 km south provided by lat/long software.
- Region modeled and displayed by TerraVision.

The Answer



Technical Significance

- Allow knowledge sources to be queried in English or logic, instead of multiple specialized languages.
- Allow answers to be inferred where not present explicitly.
- Allow answers to be obtained from multiple disparate knowledge sources.
- A deductive approach to interoperability.
- Allows easier access to knowledge sources for NASA personnel and the general public.

Facilities Used

- TerraVision 3D terrain modeling system.
- SNARK theorem prover.
- Open Agent Architecture (OAA)
information brokering system and agents:
 - Alexandria Digital Library Gazetteer
 - Latitude/Longitude Software Web Page.
 - CIA World Fact Book
- Gemini English text parser.

References

- “Deductive Response to Geographic Queries” Paper
- Deductive Composition Project
- Richard Waldinger
- Martin Reddy
- Jennifer L. Dungan